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Proposed Amendment to the Final Best Demonstrated Available Technology (BDAT) Background Document for Wastes from the Production of Chlorinated Aliphatic Hydrocarbons (F024) Volume 17

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PROPOSED

AMENDMENT TO THE

FINAL BEST DEMONSTRATED AVAILABLE TECHNOLOGY (BDAT)

BACKGROUND DOCUMENT

FOR

WASTES FROM THE PRODUCTION OF CHLORINATED ALIPHATIC HYDROCARBONS

F024

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This addendnum to the BDAT Background Document for F024 presents F024 incinerator ash stabilization data; EPA s rationale and technical support for selecting the metal constituents being proposed for regulation in nonwastewater forms of F024; and EPA's approach to and technical support for developing treatment standards for these constituents.

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1.0 INTRODUCTION

On June 8, 1989, in accordance with the amendments to the Resource Conservation and Recovery Act (RCRA) of 1976, enacted by the Hazardous and Solid Waste Amendments (HSWA) of November 8, 1984, the United States Environmental Protection Agency (EPA or Agency) established best demonstrated available technology (BDAT) treatment standards for the listed hazardous waste identified in Title 40, Code of Federal Regulations, Section 261.31 (40 CFR 261.31) as F024. Under 40 CFR 261.31, wastes identified as F024 are listed as follows:

> F024 - Wastes, including but not limited to, distillation residues, heavy ends, tars, and reactor clean-out wastes from the production of chlorinated aliphatic hydrocarbons, having carbon content from one to five, utilizing free radical catalyzed processes. (This listing does not include light ends, spent filters and filter aids, spent desiccants, wastewater, wastewater treatment sludges, spent catalysts, and wastes listed in 40 CFR 261.32).

(See the Second Third Final Rule, 54 Federal Register 26594, June 23, 1989.) Compliance with these BDAT treatment standards is a prerequisite under 40 CFR Part 268 for placement of F024 in land disposal units.

After the close of the comment period, the Agency completed its analysis of Toxicity Characteristic Leaching Procedure (TCLP) extracts (leachate) obtained from the stabilization testing of F024 incinerator ash. However, because these data were not available for public notice and comment, and because the resultant treatment standards were significantly different from the proposed standards, EPA reserved, and therefore did not issue,

treatment standards for metal constituents in nonwastewater forms of F024 in the Second Third Final Rule. The results of this analysis show substantial reduction of metals concentrations in the TCLP extracts after stabilization using a cement binder. Therefore, the Agency is proposing treatment standards for metal constituents in F024 nonwastewaters based on these data. The specific regulated constituents and treatment standards are listed in Table 1-1, at the end of this section. The treatment standards in the Second Third Final Rule for organic constituents in nonwastewater forms of F024 and for organic and metal constituents in wastewater forms of F024 are not being revised at this time.

This addendum to the Final Best Demonstrated Available Technology (BDAT) Background Document for F024 presents (1) F024 incinerator ash stabilization data; (2) EPA's rationale and technical support for selecting the metal constituents being proposed for regulation in nonwastewater forms of F024; and (3) EPA's approach to and technical support for developing treatment standards for these constituents.

Sections 2.0 through 5.0 of this document supplement discussions in the Final BDAT Background Document for F024 to present treatment performance data, accuracy-corrected data, metal constituents selected for proposed regulation in F024 nonwastewaters, and calculation of proposed treatment standards, respectively. Section 6.0 contains acknowledgements, and Section 7.0 lists references. Appendix A presents data from analysis of variance (ANOVA) tests comparing binders used in the stabilization tests. Appendix B

lists plant codes, and Appendix C contains quality assurance/quality control data.

The Agency's legal authority and promulgated methodology for establishing treatment standards and the petition process necessary for requesting a variance from the treatment standards are summarized in EPA's Methodology for Developing BDAT Treatment Standards (Reference 1).

Table 1-1

PROPOSED BDAT TREATMENT STANDARDS FOR METAL CONSTITUENTS IN F024 NONWASTEWATERS

Maximum for any Single Grab Sample	
BDAT List Constituent	Concentration in the TCLP Extract (mg/l)
159. Chromium (total)	0.073
161. Lead	0.021
162. Nickel	0.088

2.0 ADDENDUM TO SECTION 4.0 (TREATMENT PERFORMANCE DATA BASE) OF THE FINAL BDAT BACKGROUND DOCUMENT FOR F024

This section supplements the discussion in Section 4.0 (Treatment Performance Data Base) of the Final BDAT Background Document for F024. This section presents the treatment performance data for the stabilization of F024 incinerator ash. F024 incinerator ash was generated at Plant X and stabilized at Plant Y. The names and locations of these plants are listed in Appendix B.

Tables 2-1, 2-2, and 2-3 each present three sample sets of treatment performance data for the stabilization of F024 incinerator ash using a cement binder, a lime/fly ash binder, and a kiln dust binder, respectively. Table 2-4 presents test conditions that were present during the stabilization tests.

Table 2-1

ANALYTICAL RESULTS FOR THE UNTREATED AND STABILIZED F024 INCINERATOR ASH SAMPLES

CEMENT BINDER

Binder-to-Ash Ratio: 0.55
Water-to-Ash Ratio: 0.2

BDAT List Constituent	Detection Limit (mg/l)	Concentration in the TCLP Extract of the Untreated Waste (mg/l) Sample Set 1	Sample Set 2	Sample Set 3	Concentration in the TCLP Extract of the Treated Waste (28-Day Cure) (mg/l) Sample Set 1	Sample Set 2	Sample Set 3
154. Antimony	0.076	ND	ND	ND	ND	ND	ND
155. Arsenic	0.002	0.013	0.015	0.014	0.004	0.002	0.002
156. Barium	0.002	1.99	1.72	1.67	1.84	0.88	1.02
157. Beryllium	0.001	0.002	0.002	0.002	ND	ND	ND
158. Cadmium	0.003	0.021	0.021	0.021	ND	ND	ND
159. Chromium (total)	0.007	0.4	0.41	0.42	0.031	0.01	0.013
221. Chromium (VI)	0.006	0.34	0.075	0.049	0.19	0.15	0.14
160. Copper	0.018	5.54	6.71	9.59	ND	ND	ND
161. Lead	0.057	63.3	33.3	14.9	0.011	0.006	0.007
162. Mercury	0.0003	0.0006	ND	ND	ND	ND	ND
163. Nickel	0.025	4.39	3.96	3.93	ND	ND	ND
164. Selenium	0.002	ND	ND	ND	ND	ND	ND
165. Silver	0.004	ND	ND	ND	ND	ND	ND
166. Thallium	0.004	ND	ND	ND	ND	ND	ND
167. Vanadium	0.007	ND	ND	ND	ND	ND	ND
168. Zinc	0.003	2.06	2.07	2.06	0.041	0.05	0.173

ND-Not detected.

Source: Draft Onsite Engineering Report of Treatment Technology Performance and Operation for Waterways Experiment Station, Vicksburg, Mississippi (Reference 2).

Table 2-2

ANALYTICAL RESULTS FOR THE UNTREATED AND STABILIZED F024 INCINERATOR ASH SAMPLES

LIME/FLY ASH BINDER

Binder-to-Ash Ratio: 0.5/0.5
Water-to-Ash Ratio: 0.2

BDAT List Constituent	Detection Limit (mg/l)	Concentration in the TCLP Extract of the Untreated Waste (mg/l) Sample Set 1	Sample Set 2	Sample Set 3	Concentration in the TCLP Extract of the Treated Waste (28-Day Cure) (mg/l) Sample Set 1	Sample Set 2	Sample Set 3
154. Antimony	0.076	ND	ND	ND	0.088	ND	ND
155. Arsenic	0.002	0.013	0.015	0.014	0.004	0.003	0.002
156. Barium	0.002	1.99	1.72	1.67	1.95	2.03	0.34
157. Beryllium	0.001	0.002	0.002	0.002	ND	ND	ND
158. Cadmium	0.003	0.021	0.021	0.021	ND	ND	ND
159. Chromium (total)	0.007	0.4	0.41	0.42	0.097	0.024	ND
221. Chromium (VI)	0.006	0.34	0.075	0.049	0.07	0.07	0.072
160. Copper	0.018	5.54	6.71	9.59	ND	0.13	0.056
161. Lead	0.057	63.3	33.3	14.9	0.069	0.23	0.3
162. Mercury	0.0003	0.0006	ND	ND	ND	ND	ND
163. Nickel	0.025	4.39	3.96	3.93	0.33	0.75	0.84
164. Selenium	0.002	ND	ND	ND	ND	ND	0.005
165. Silver	0.004	ND	ND	ND	ND	ND	ND
166. Thallium	0.004	ND	ND	ND	ND	ND	ND
167. Vanadium	0.007	ND	ND	ND	ND	ND	ND
168. Zinc	0.003	2.06	2.07	2.06	0.15	0.65	0.23

ND-Not detected.

Source: Draft Onsite Engineering Report of Treatment Technology Performance and Operation for Waterways Experiment Station, Vicksburg, Mississippi (Reference 2).

Table 2-3

ANALYTICAL RESULTS FOR THE UNTREATED AND STABILIZED F024 INCINERATOR ASH SAMPLES

KILN DUST BINDER

Binder-to-Ash Ratio: 0.4
Water-to-Ash Ratio: 0.2

BDAT List Constituent	Detection Limit (mg/l)	Concentration in the TCLP Extract of the Untreated Waste (mg/l) Sample Set 1	Sample Set 2	Sample Set 3	Concentration in the TCLP Extract of the Treated Waste (28-Day Cure) (mg/l) Sample Set 1	Sample Set 2	Sample Set 3
154. Antimony	0.076	ND	ND	ND	ND	ND	ND
155. Arsenic	0.002	0.013	0.015	0.014	0.002	0.002	0.003
156. Barium	0.002	1.99	1.72	1.67	0.54	0.55	4.62
157. Beryllium	0.001	0.002	0.002	0.002	ND	ND	ND
158. Cadmium	0.003	0.021	0.021	0.021	ND	ND	ND
159. Chromium (total)	0.007	0.4	0.41	0.42	0.19	ND	0.033
221. Chromium (VI)	0.006	0.34	0.075	0.049	0.12	0.11	0.15
160. Copper	0.018	5.54	6.71	9.59	ND	0.024	ND
161. Lead	0.057	63.3	33.3	14.9	0.059	0.065	0.08
162. Mercury	0.0003	0.0006	ND	ND	ND	ND	ND
163. Nickel	0.025	4.39	3.96	3.93	0.07	ND	ND
164. Selenium	0.002	ND	ND	ND	0.006	0.006	ND
165. Silver	0.004	ND	ND	ND	ND	ND	ND
166. Thallium	0.004	ND	ND	ND	ND	ND	ND
167. Vanadium	0.007	ND	ND	ND	ND	ND	ND
168. Zinc	0.003	2.06	2.07	2.06	0.074	0.16	0.13

ND-Not detected.

Source: Draft Onsite Engineering Report of Treatment Technology Performance and Operation for Waterways Experiment Station, Vicksburg, Mississippi (Reference 2).

Table 2-4

TEST CONDITIONS FOR THE STABILIZATION TESTS

Parameter	Specification
Mixing Vessel	Hobart K455S Mixer With Teflon Beaters 4-Liter Stainless Steel Bowl
Mixing Conditions	Mixing Procedure Used for All Batches: Mix 5 minutes in mixing vessel Scrape mixer by hand with stainless steel spatula
Cure Conditions	Hot Pack Model 41750 Large Capacity Humidity Chamber with set point conditions of: Temperature: 23°C Humidity: 95-98%

Source: Draft Onsite Engineering Report of Treatment Technology Performance and Operation for Waterways Experiment Station, Vicksburg, Mississippi (Reference 2).

3.0 ADDENDUM TO SECTION 5.0 (IDENTIFICATION OF BEST DEMONSTRATED AVAILABLE TECHNOLOGY) OF THE FINAL BDAT BACKGROUND DOCUMENT FOR F024

This section supplements the discussion in Section 5.0 (Identification of Best Demonstrated Available Technology) of the Final BDAT Background Document for F024. This section presents accuracy-corrected concentration data for metal constituents detected in either F024 incinerator ash or the stabilized waste and discusses the statistical comparison of treatment performance data. Quality assurance/quality control data are presented in Appendix C of this document.

Matrix spike recoveries were used to adjust the treatment performance data from the stabilization of F024 incinerator ash. These matrix spike recoveries are presented in Table C-1 of Appendix C of this document. Duplicate matrix spikes were performed for some BDAT List constituents in the treatment residual. If a duplicate matrix spike was performed for a constituent, the matrix spike recovery used to adjust treatment performance data for that constituent was the lower of the two values from the first matrix spike and the duplicate spike.

Accuracy correction factors that were calculated for stabilized F024 incinerator ash data are presented in Table C-2 of Appendix C of this document. Treatment performance data for each BDAT List metal constituent detected in either the untreated F024 incinerator ash or the stabilized F024 incinerator ash were corrected for accuracy and are presented in Table 3-1. Accuracy correction factors less than 1.0 (i.e., factors that would result in

a reduction in constituent concentration) were not used to correct treatment performance data. Instead, a correction factor of 1.0 was used in these cases.

A comparison of the treatment performance achieved by each binder was conducted using analysis of variance (ANOVA) tests (discussed fully in EPA's Methodology for Developing BDAT Treatment Standards (Reference 1)). The treatment performance data for each binder were corrected for accuracy (as discussed above) before the ANOVA tests were performed. Based on the ANOVA tests, stabilization of F024 incinerator ash using a cement binder demonstrated significantly better treatment performance than stabilization of F024 incinerator ash using either a lime/fly ash binder or a kiln dust binder. Results of the ANOVA tests are presented in Appendix A of this document.

Table 3-1

BDAT LIST CONSTITUENT
CONCENTRATIONS IN STABILIZED INCINERATOR ASH CORRECTED FOR ACCURACY[a]

CEMENT BINDER

BDAT List Constituent	Corrected Concentration in the TCLP Extract of the Stabilized F024 Incinerator Ash (mg/l) Sample Set 1	2	3
155. Arsenic	0.004	0.002	0.002
156. Barium	1.974	0.944	1.094
157. Beryllium	<0.001	<0.001	<0.001
158. Cadmium	<0.004	<0.004	<0.004
159. Chromium (total)	0.036	0.011	0.015
221. Chromium (VI)	0.209	0.165	0.154
160. Copper	<0.021	<0.021	<0.021
161. Lead	0.014	0.008	0.009
162. Mercury	<0.0003	<0.0003	<0.0003
163. Nickel	<0.031	<0.031	<0.031
168. Zinc	0.052	0.064	0.221

[a]This table presents data for the BDAT List metal constituents detected in either the untreated F024 incinerator ash or the stabilized F024 incinerator ash. These data were obtained by multiplying the concentration found in the stabilized waste (Table 2-1 in Section 2.0) by the accuracy correction factor for that constituent (Table C-2 in Appendix C).

Table 3-2

BDAT LIST CONSTITUENT
CONCENTRATIONS IN STABILIZED INCINERATOR ASH CORRECTED FOR ACCURACY[a]

LIME/FLY ASH BINDER

BDAT List Constituent	Corrected Concentration in the TCLP Extract of the Stabilized F024 Incinerator Ash (mg/l)		
	Sample Set		
	1	2	3
155. Arsenic	0.004	0.003	0.002
156. Barium	2.11	2.20	0.37
157. Beryllium	0.001	0.001	0.001
158. Cadmium	0.004	0.004	0.004
159. Chromium (total)	0.119	0.029	0.008
221. Chromium (VI)	0.07	0.07	0.072
160. Copper	0.021	0.15	0.065
161. Lead	0.085	0.28	0.4
162. Mercury	0.0006	0.0003	0.003
163. Nickel	0.41	0.93	1.04
168. Zinc	0.17	0.75	0.27

[a]This table presents data for the BDAT List metal constituents detected in either the untreated F024 incinerator ash or the stabilized F024 incinerator ash. These data were obtained by multiplying the concentration found in the stabilized waste (Table 2-2 in Section 2.0) by the accuracy correction factor for that constituent (Table C-2 in Appendix C).

Table 3-3

BDAT LIST CONSTITUENT
CONCENTRATIONS IN STABILIZED INCINERATOR ASH CORRECTED FOR ACCURACY[a]

KILN DUST BINDER

BDAT List Constituent	Corrected Concentration in the TCLP Extract of the Stabilized F024 Incinerator Ash (mg/l)		
	Sample Set		
	1	2	3
155. Arsenic	0.002	0.002	0.003
156. Barium	0.56	0.57	4.82
157. Beryllium	0.001	0.001	0.001
158. Cadmium	0.004	0.004	0.004
159. Chromium (total)	0.24	0.009	0.041
221. Chromium (VI)	0.12	0.11	0.15
160. Copper	0.021	0.028	0.021
161. Lead	0.084	0.092	0.11
162. Mercury	0.0006	0.0003	0.0003
163. Nickel	0.09	0.032	0.032
168. Zinc	0.09	0.19	0.16

[a]This table presents data for the BDAT List metal constituents detected in either the untreated F024 incinerator ash or the stabilized F024 incinerator ash. These data were obtained by multiplying the concentration found in the stabilized waste (Table 2-3 in Section 2.0) by the accuracy correction factor for that constituent (Table C-2 in Appendix C).

4.0 ADDENDUM TO SECTION 6.0 (SELECTION OF REGULATED CONSTITUENTS) OF THE FINAL BDAT BACKGROUND DOCUMENT FOR F024

This section supplements the discussion in Section 6.0 (Selection of Regulated Constituents) of the Final BDAT Background Document for F024. This section presents a discussion of the selection of metal constituents for proposed regulation in nonwastewater forms of F024.

Generally, constituents selected for regulation must satisfy the following criteria:

1) The constituent must be on the BDAT List of regulated constituents. Presence on the BDAT List means that approved methods to analyze for the constituent in treated waste matrices exist.

2) The constituent must be present in, or be suspected of being present in, the untreated waste. For example, in some cases, analytical difficulties (such as masking) may prevent a constituent from being identified in the untreated waste, but its identification in a treatment residual may lead the Agency to conclude that it is present in the untreated waste.

From a group of constituents that are eligible for regulation, because they meet the above criteria, EPA may select a subset of constituents that represent the broader group. For example, from a group of constituents that react similarly to treatment, the Agency may select for regulation only those constituents that (1) are the most difficult to treat; or (2) are present in the untreated waste in the highest concentrations. Selecting a subset of constituents for regulation is done to facilitate implementation of the compliance and enforcement program.

The Agency initially considered all metal constituents on the BDAT List for proposed regulation in nonwastewater forms of F024. Available F024 characterization data for the BDAT List metal constituents are summarized in Table 4-1. (All tables are presented at the end of this section.) When data are available from more than one sample set, a range of detected concentrations is shown in the table for all constituents quantified in the untreated F024. Constituents that were not detected in the untreated waste but were detected in the treated waste are identified by the symbol "*." The Agency is not regulating all of the BDAT List metal constituents considered for regulation, as discussed in the following subsections.

4.1 BDAT List Metals Constituents Deleted from Consideration for Proposed Regulation

A BDAT List metal constituent was deleted from further consideration for regulation if (1) the constituent was not detected in the untreated and/or treated wastes, (2) available treatment performance data for the constituent did not show effective treatment by BDAT, (3) the constituent was not present at treatable concentrations in the waste, or (4) other reasons, as described below. BDAT List constituents that remained following the deletions described in this subsection were further considered for regulation.

Beryllium, hexavalent chromium, selenium, silver, and thallium were not detected in the untreated and/or treated wastes and were therefore deleted from further consideration for proposed regulation in F024 nonwastewaters.

Antimony, barium, and mercury were deleted from further consideration for proposed regulation in F024 nonwastewaters because the BDAT treatment performance data obtained from stabilization of F024 incinerator ash do not show effective treatment for these constituents.

Arsenic and cadmium were deleted from further consideration for proposed regulation in F024 nonwastewaters because they were not present in the untreated waste at treatable concentrations.

Copper, vanadium, and zinc were considered for proposed regulation in F024 nonwastewaters but were not selected as constituents to be proposed for regulation. Although copper cyanide, vanadium pentoxide, and zinc cyanide are listed in Appendix VIII of 40 CFR Part 261, the metals are not listed individually. The Agency is only proposing regulation of copper, vanadium, and/or zinc when they are indicators of performance of treatment for other Appendix VIII constituents (i.e., copper cyanide, vanadium pentoxide, and zinc cyanide). For F024, copper, vanadium, and zinc have not been identified as indicators of treatment for other Appendix VIII constituents and therefore, are not being proposed for regulation.

4.2 Selection of BDAT List Metal Constituents for Proposed Regulation

Based on the discussion in Section 4.1, three metal constituents were selected for proposed regulation in F024 nonwastewaters. These constituents are total chromium, lead, and nickel.

Table 4-1

STATUS OF BDAT LIST CONSTITUENT PRESENCE
IN UNTREATED F024

BDAT List Constituent	Detection Status	Concentration in Untreated F024 (mg/kg)
154. Antimony	X	<1.8-2.2
155. Arsenic	X	<0.86-7.8
156. Barium	X	0.22-34
157. Beryllium	*	<0.1
158. Cadmium	X	<0.26-3.1
159. Chromium (total)	X	<0.4-285
221. Chromium (hexavalent)	ND	<10
160. Copper	X	<0.4-800
161. Lead	X	<0.43-9.0
162. Mercury	X	<0.1-0.24
163. Nickel	X	<0.9-636
164. Selenium	*	<0.5
165. Silver	ND	<0.4
166. Thallium	ND	<10
167. Vanadium	X	<0.17-10
168. Zinc	X	0.73-443

X - Indicates that a constituent was quantified at or above its detection limit in one or more untreated F024 samples.
* - Not detected in the untreated F024, but detected in the incinerator ash.
ND - Not detected in either the untreated F024 or in the incinerator ash.

Source: Final Best Demonstrated Available Technology (BDAT) Background Document for F024 (Reference 3).

5.0 ADDENDUM TO SECTION 7.0 (CALCULATION OF BDAT TREATMENT STANDARDS) OF THE FINAL BDAT BACKGROUND DOCUMENT FOR F024

This section supplements the discussion in Section 7.0 (Calculation of BDAT Treatment Standards) of the Final BDAT Background Document for F024. This section includes a discussion of the calculation of proposed treatment standards for metal constituents in F024 nonwastewaters.

Proposed BDAT treatment standards for metal constituents in F024 nonwastewater residuals were calculated based on three sample sets of treatment performance data from the stabilization of F024 incinerator ash using a cement binder. The cement binder was determined to provide the best treatment for metal constituents in F024 incinerator ash, as discussed in Section 3.0 of this document. Table 5-1 presents the concentrations of metal constituents in the TCLP extract of the stabilized F024 rotary kiln incinerator ash. Concentration data are presented for only those constituents selected for regulation, as discussed in Section 4.0 of this document. The concentration data presented in Table 5-1 have been corrected for accuracy to account for analytical recovery, as described in Section 3.0.

The proposed treatment standards for F024 nonwastewaters were calculated for metal constituents being proposed for regulation in F024, as shown in Table 5-2. The following three steps were used to calculate the treatment standards:

(1) The arithmetic average of the accuracy-corrected concentrations for each regulated constituent in the treated waste was calculated using the data presented in Tables 2-1 and C-2 of this document.

(2) Using the same data, a variability factor (discussed in EPA's Methodology for Developing BDAT Treatment Standards) was calculated that represents the variability inherent in the performance of the treatment system, the collection of treated samples, and the analysis of samples. Where concentrations in the treated waste were reported as less than or equal to the detection limit for all the data points in the data set, variability is still expected, since the actual concentrations could range from zero to the detection limit. In these cases, the Agency assumed a lognormal distribution of data points between the detection limit and a value one-tenth of the detection limit and then calculated a variability factor of 2.8. Variability factor calculations are shown in Appendix D of this document with the detailed treatment standard calculations.

(3) The proposed treatment standard for each constituent to be regulated was calculated by multiplying the arithmetic average of the accuracy-corrected concentrations (step (1) above) by the variability factor (step (2) above).

Table 5-1

CORRECTED CONCENTRATION DATA FOR METAL CONSTITUENTS IN STABILIZED F024 INCINERATOR ASH

CEMENT BINDER

	BDAT List Constituent	Corrected Concentration[a] in the TCLP Extract of the Stabilized F024 Incinerator Ash (mg/l)		
		Sample Set		
		1	2	3
159.	Chromium (total)	0.036	0.011	0.015
161.	Lead	0.014	0.008	0.009
163.	Nickel	<0.031	<0.031	<0.031

[a]Constituent concentrations have been adjusted for accuracy to account for analytical recoveries ("corrected"), as discussed in Section 3.0.

Table 5-2

CALCULATION OF PROPOSED TREATMENT STANDARDS FOR METAL CONSTITUENTS IN F024 NONWASTEWATERS

Regulated Constituent	Arithmetic Average of Corrected Treatment Values (ppm)	Variability Factor (VF)	Treatment Standard[a] (Average x VF) (ppm)
159. Chromium (total)	0.021	3.5	0.073
161. Lead	0.010	2.0	0.021
163. Nickel	0.031	2.8	0.088

[a]The treatment standard values shown in this table have been rounded off to show two significant figures.

6.0 ACKNOWLEDGEMENTS

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The following personnel from Radian Corporation were involved in preparing this document: Mr. John Williams, Program Manager; Ms. Lori Stoll, Project Director; and Ms. Chrisanti Haretos, Task Leader.

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7.0 REFERENCES

1. U.S. EPA. 1989. U.S. Environmental Protection Agency, Office of Solid Waste. Methodology for Developing BDAT Treatment Standards. June, 1989. Washington, D.C.: U.S. Environmental Protection Agency.

2. U.S. EPA. 1989. U.S. Environmental Protection Agency, Office of Solid Waste. Draft Onsite Engineering Report of Treatment Technology Performance and Operation for Waterways Experiment Station, Vicksburg, Mississippi. August, 1989. Washington, D.C.: U.S. Environmental Protection Agency.

3. U.S. EPA. 1989. U.S. Environmental Protection Agency, Office of Solid Waste. Final Best Demonstrated Available Technology (BDAT) Background Document for F024. May, 1989. Washington, D.C.: U.S. Environmental Protection Agency.

4. U.S. EPA. June 23, 1988. U.S. Environmental Protection Agency, Office of Solid Waste. Land Disposal Restrictions for Second Third Schedule Wastes. 54 FR 26594. Washington, D.C.: U.S. Environmental Protection Agency.

Appendix A

RESULTS OF THE ANALYSIS OF VARIANCE (ANOVA) TESTS COMPARING THE THREE BINDERS USED TO STABILIZE F024 INCINERATOR ASH

Appendix A

Analysis of variance (ANOVA) tests were conducted to compare the treatment performance achieved by three binders (cement, lime/fly ash, and kiln dust) used to stabilize F024 incinerator ash. The metal constituents selected for proposed regulation were considered individually and collectively in these tests. Results of the ANOVA tests are summarized in Table A-1. As demonstrated in Table A-1, the cement binder performed as well as or better than the other two binders in all test cases.

Table A-1

SUMMARY OF ANOVA TESTS COMPARING THE TREATMENT PERFORMANCE
ACHIEVED BY STABILIZATION USING CEMENT, LIME/FLY ASH, AND KILN DUST BINDERS

Metal Constituent(s)	Binders Compared[a]	F-Ratio	Critical Value	Homogeneous (H) or Non-homogeneous (N)	Statistical Interpretation
Chromium	2 vs. 3	0.10	7.71	H	no significant difference
	1 vs. 3	0.83	7.71	H	no significant difference
	1 vs. 2	0.39	7.71	H	no significant difference
Lead	2 vs. 3	2.87	7.71	H	no significant difference
	1 vs. 3	142.93	7.71	N	cement binder is best
	1 vs. 2	37.49	7.71	N	cement binder is best
Nickel	2 vs. 3	37.96	7.71	N	kiln dust binder is best
	1 vs. 3	1.19	7.71	H	no significant difference
	1 vs. 2	116.38	7.71	N	cement binder is best
Chromium, Lead, and Nickel	2 vs. 3	2.91	4.49	H	no significant difference
	1 vs. 3	9.90	4.49	N	cement binder is best
	1 vs. 2	15.27	4.49	N	cement binder is best

[a]Binders:
1 - cement
2 - lime/fly ash
3 - kiln dust

Appendix B

PLANT CODES

Table B-1

PLANT CODES

Code	Plant	Location
X	Waterways Experiment Station	Vicksburg, Mississippi
Y	ENSCO	El Dorado, Arkansas

Appendix C

QUALITY ASSURANCE/QUALITY CONTROL DATA

Table C-1

STABILIZED F024 INCINERATOR ASH MATRIX SPIKE RECOVERIES FOR METAL CONSTITUENTS

Cement Binder: Sample Set 2

BDAT List Constituent	Original Amount Found[a] (ppm)	Amount Spiked (ppm)	Sample Result		Duplicate Sample Result		Relative Percent Difference (%)
			Amount Recovered (ppm)	Percent Recovery[b] (%)	Amount Recovered (ppm)	Percent Recovery[b] (%)	
155. Arsenic	0.0036	0.1	0.105	101.3	0.109	105	3.7
156. Barium	1.84	2	3.70	93.2	3.78	97.2	2.1
157. Beryllium	<0.0009	2	1.74	87.1	1.75	87.6	0.6
158. Cadmium	<0.0027	2	1.61	80.3	1.62	80.9	0.8
159. Chromium (total)	0.0311	2	1.77	87.2	1.79	88.0	0.9
221. Chromium (VI)	0.00944	0.010	0.0185	90.8	0.185	90.8	0.0
160. Copper	<0.0179	2	1.71	85.6	1.71	85.6	0.0
161. Lead	0.0112	0.075	0.007	78.4	0.0735	83.1	4.9
162. Mercury	0	0.0005	0.000483	96.6	0.000497	99.4	2.9
163. Nickel	<0.0249	2	1.61	80.5	1.59	79.7	1.0
168. Zinc	0.0406	2	1.61	78.3	1.66	81.2	3.5

[a]For constituents not detected in the treatment residual at or above the detection limit, the original amount found is considered zero in calculating percent recovery.

[b]Percent recovery = 100 x $(C_1-C_0)/C_t$, where C_1 = amount recovered, C_0 = original amount found, and C_t = amount spiked.

Source: Draft Onsite Engineering Report of Treatment Technology Performance and Operation on F024 Incinerator Ash for Waterways Experiment Station, Vicksburg, Mississippi (Reference 2).

Table C-1 (Continued)

STABILIZED F024 INCINERATOR ASH MATRIX SPIKE RECOVERIES FOR METAL CONSTITUENTS

Lime/Fly Ash Binder: Sample Set 2

BDAT List Constituent	Original Amount Found[a] (ppm)	Amount Spiked (ppm)	Sample Result		Duplicate Sample Result		Relative Percent Difference (%)
			Amount Recovered (ppm)	Percent Recovery[b] (%)	Amount Recovered (ppm)	Percent Recovery[b] (%)	
154. Antimony	0.0877	4	3.96	96.9	3.93	96.1	0.7
155. Arsenic	0.0035	0.1	0.105	102	0.103	99.7	1.8
156. Barium	1.95	2	3.80	92.3	3.90	97.3	2.6
157. Beryllium	<0.0009	2	1.75	87.5	1.76	88.2	0.8
158. Cadmium	<0.0027	2	1.58	79.2	1.58	79.1	0.1
159. Chromium (total)	0.0967	2	1.73	81.9	1.73	81.7	0.2
221. Chromium (VI)	0.00357	0.010	0.0152	117	0.0138	103	9.8
160. Copper	<0.0179	2	1.73	86.6	1.74	87.1	0.6
161. Lead	0.0693	0.075	0.131	82.3	0.130	80.8	0.8
162. Mercury	0	0.0005	0.000493	98.6	0.000502	100	1.8
163. Nickel	0.3251	2	1.94	80.9	1.95	81.4	0.5
164. Selenium	0	0.1	0.0438	43.8	0.0437	43.7	0.2
165. Silver	<0.0040	2	1.80	90.2	1.81	90.6	0.4
166. Thallium	0	0.075	0.0453	60.4	0.043	57.3	5.2
167. Vanadium	<0.0072	2	1.68	84.3	1.70	85.1	1.0
168. Zinc	0.151	2	1.92	88.3	1.88	86.2	2.2

[a]For constituents not detected in the treatment residual at or above the detection limit, the original amount found is considered zero in calculating percent recovery.

[b]Percent recovery = $100 \times (C_1 - C_o)/C_t$, where C_1 = amount recovered, C_o = original amount found, and C_t = amount spiked.

Source: Draft Onsite Engineering Report of Treatment Technology Performance and Operation on F024 Incinerator Ash for Waterways Experiment Station, Vicksburg, Mississippi (Reference 2).

Table C-1 (Continued)

STABILIZED F024 INCINERATOR ASH MATRIX SPIKE RECOVERIES FOR METAL CONSTITUENTS

Kiln Dust Binder: Sample Set 2

BDAT List Constituent	Original Amount Found[a] (ppm)	Amount Spiked (ppm)	Sample Result		Duplicate Sample Result		Relative Percent Difference (%)
			Amount Recovered (ppm)	Percent Recovery[b] (%)	Amount Recovered (ppm)	Percent Recovery[b] (%)	
154. Antimony	<0.0755	4	3.83	95.7	3.83	95.8	0.0
155. Arsenic	0.0015	0.1	0.1	98.5	0.100	98.6	0.1
156. Barium	0.540	2	2.46	95.8	2.46	96.0	0.2
157. Beryllium	<0.0009	2	1.67	83.7	1.68	84.2	0.6
158. Cadmium	<0.0027	2	1.55	77.5	1.57	78.6	1.3
159. Chromium (total)	0.192	2	1.80	80.4	1.81	81.0	0.7
221. Chromium (VI)	0.00290	0.010	0.0141	112	0.0141	112	0.0
160. Copper	<0.0179	2	1.71	85.6	1.71	85.7	0.1
161. Lead	0.0588	0.075	0.112	70.5	0.11	75.2	3.1
162. Mercury	0	0.0005	0.000512	102	0.000507	101	1.0
163. Nickel	0.0696	2	1.63	78.1	1.65	79.2	1.4
164. Selenium	0.0061	0.1	0.061	54.9	0.0618	55.7	1.3
165. Silver	<0.0040	2	1.77	88.4	1.78	88.8	0.4
166. Thallium	0	0.075	0.0838	112	0.0669	89.2	22.4
167. Vanadium	<0.0072	2	1.66	82.9	1.68	84.2	1.6
168. Zinc	0.0738	2	1.66	79.2	1.74	83.4	5.0

[a]For constituents not detected in the treatment residual at or above the detection limit, the original amount found is considered zero in calculating percent recovery.

[b]Percent recovery = 100 x $(C_i - C_o)/C_t$, where C_i = amount recovered, C_o = original amount found, and C_t = amount spiked.

Source: Draft Onsite Engineering Report of Treatment Technology Performance and Operation on F024 Incinerator Ash for Waterways Experiment Station, Vicksburg, Mississippi (Reference 2).

Table C-2

SUMMARY OF ACCURACY CORRECTION FACTORS
FOR METAL CONSTITUENTS IN STABILIZED F024 INCINERATOR ASH

BDAT List Constituent	Accuracy Correction Factor[a]		
	Cement Binder	Lime/Fly Ash Binder	Kiln Dust Binder
155. Arsenic	1.000	1.003	1.015
156. Barium	1.073	1.083	1.044
157. Beryllium	1.148	1.143	1.195
158. Cadmium	1.245	1.264	1.290
159. Chromium (total)	1.147	1.224	1.244
221. Chromium (VI)	1.101	1.000	1.000
160. Copper	1.168	1.155	1.68
161. Lead	1.276	1.238	1.418
162. Mercury	1.035	1.014	1.000
163. Nickel	1.255	1.236	1.280
168. Zinc	1.277	1.160	1.212

[a]The accuracy correction factor is equal to 100 divided by the percent recovery. An accuracy correction factor of 1 was used when matrix spike and duplicate matrix recoveries both exceeded 100%, so that the data were not adjusted to concentrations below the detection limits.

Appendix D

DETAILED CALCULATIONS OF TREATMENT STANDARDS FOR METAL CONSTITUENTS IN F024 NONWASTEWATERS

Table D-1

DETAILED CALCULATIONS OF TREATMENT STANDARDS FOR METAL CONSTITUENTS IN F024 NONWASTEWATERS

Regulated Constituent	Sample Set 1	Sample Set 2	Sample Set 3	Ln of values 1	Ln of values 2	Ln of values 3	Mean of Adjusted Values (mg/kg)	Mean of Lns of Adjusted Values	Standard Deviation of Lns	C99	Variability Factor (VF)	Treatment Standard (mg/kg)
159. Chromium (total)												
unadjusted value (mg/kg)	0.031	0.010	0.013									
a or dl	a	a	a									
ACF	1.147	1.147	1.147									
adjusted value (mg/kg)**	0.036	0.011	0.015	-3.337	-4.468	-4.206	0.021	-4.004	0.592	0.073	3.513	0.073
161. Lead												
unadjusted value (mg/kg)	0.011	0.006	0.007									
a or dl	a	a	a									
ACF	1.276	1.276	1.276									
adjusted value (mg/kg)**	0.014	0.008	0.009	-4.267	-4.873	-4.718	0.010	-4.619	0.315	0.021	2.013	0.021
163. Nickel												
unadjusted value (mg/kg)	0.025	0.025	0.025									
a or dl	dl	dl	dl									
ACF	1.255	1.255	1.255									
adjusted value (mg/kg)**	0.031	0.031	0.031	-3.462	-3.462	-3.462	0.031	-3.462	0.000	0.031	2.800	0.088

a - actual concentration of the constituent in the treatment residual (if quantified above the detection limit)
dl - detection limit of the constituent in the treatment residual (if not quantified above the detection limit)

** Adjusted values were calculated by multiplying the unadjusted value by the accuracy correction factor.

C99 = exp(mean of lns of adjusted values + (standard deviation of lns x 2.33))

Variability factor = (C99 / mean of adjusted values). A variability factor of 2.8 was used when a constituent was not detected (dl) in all sample sets in which it was analyzed for.

Treatment standard = (mean of adjusted values x variability factor)

Note: The unadjusted values and matrix spike data for these calculations were taken from stabilization of F024 incinerator ash at Waterways Experiment Station.